APPENDIX E06

Sewage Treatment Effluent Technical Memorandums

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Memo

To:	Chris Hanks, Bill Patterson, Greg Blaylock	**Date:**	January 28, 2011
cc:		**From:**	Iozsef Miskolczi, Maritz Rykaart
Subject:	Doris North Project – Alternate Land Application Strategy for Discharge of Sewage Treatment Effluent	**Project #:**	1CH008.033

1 Introduction

Hope Bay Mining Limited (HBML), a wholly owned subsidiary of Newmont Mining Company (NMC) is currently in the process of constructing their Doris North Project (Project) in the Kitikmeot region of Nunavut, Canada. Effluent from the sewage treatment plant at Doris Camp should, according to the Water License, be pumped to the Tailings Storage Facility at Tail Lake once the mine is in production. During the construction phase of the project, HBML may discharge the effluent at a designated land application location. The construction period is however longer than initially anticipated, and as a result; permafrost degradation has started at the land application area.

The Nunavut Water Board (NWB) has subsequently requested that HBML consider alternate land application methods or construct a suitable diffuser system on the outlet to ensure that the degradation does not increase.

SRK was tasked to investigate possible diffuser system designs, as well as investigate alternate land application systems. These concepts were presented to HBML, and the resultant decision was to implement an alternate land application strategy as opposed to installation of a diffuser. This memo provides details of this system.

2 Current Effluent Discharge Strategy

Currently the sewage effluent is discharged via a 945 m long heat-traced HDPE pipeline to a fixed discharge location situated about 50 m NNW of the access road to Quarry #2. The discharge point is slightly elevated above ground via a wooden truss structure and is allowed to flow out as a single point discharge directly onto the tundra.

During the summer season, the soil around the discharge point becomes over-saturated for extended periods of time, which has led to vegetation die-back. This absence of vegetation exacerbates the localised erosion caused by the flowing water. This leads to the formation of a pool of standing water, which in turn changes the thermal regime of the soil immediately adjacent causing localised degradation of permafrost. This physical and thermal erosion will continue unless an alternate strategy is adopted.

During the winter months, this discharge method results in glaciated sheets of ice around the discharge point. This ice melts slowly during spring break-up, further leading to over-saturation and subsequent vegetation die-back of the area in question.

3 Alternate Land Application Strategy for Effluent Discharge

SRK evaluated a number of different strategies for improving the situation (see Attachment A). After consultation with HBML, it was concluded that the best strategy would be to implement an alternate land application strategy, which would allow redistribution of the effluent over a larger land surface area as opposed to try and construct a single point diffuser.

3.1 Design Constraints

The Sewage Treatment Plant was designed as a batch discharge system, meaning that the treated water is allowed to accumulate in a holding tank which is emptied every time it reaches full capacity. This discharge method translates into intermittent flow onto the discharge area, but the volume of effluent discharged every time is far greater than the capacity of the soil to absorb, store, and subsequently evaporate the water.

The capacity of the treatment plant and the volume of the holding tank were designed based on a predicted water usage of 285 L/person/day. The camp occupancy is projected to increase up to 360 persons starting in June 2011. This will cause a two-fold increase in the volume of effluent discharged, compared to current (2010) volumes.

The batch discharge method will be maintained, but the capacity of the STP will be augmented to support the increased camp population. The existing discharge pipeline will be used for the new land application system and the effluent will be discharged in the same general area as previously. This is illustrated in Figure 1

To ensure compliance with all appropriate permits and licenses, the discharge area will be at least 30 m away from any flowing or standing water body. No direct discharge from any surface water body is intended.

The design of the new land application system will avoid extended periods of oversaturation of the soil, as well as reduce the energy of the discharging water to avoid soil, and subsequent thermal erosion. Based on current Camp planning, the system should be operational between January 2011 and June 2013, inclusively. The discharge line would then be moved to the Tailings Storage Facility.

3.2 Design Concept

The effective rate of infiltration and storage capacity of the soil was calculated based on the Green-Ampt equation. The calculation assumed an effective void ratio of 0.42 and a maximum depth of the active layer of 1.0 m. Lateral flow in the soil was assumed negligible. It was found that an area of approximately 16 Hectares (about 40 Acres) is required to store the volume of effluent produced in one year. Discharging water on such a large area is not practical, especially in the tundra location of Doris Camp where the landscape is fragmented by numerous fish-bearing streams and lakes.

The alternative to point-discharge is the use of a sprinkler system, which in effect is a diffuser allowing the distribution of the effluent on a relatively large area. Installing multiple sprinklers allows rotation of the discharge locations, thus allowing the water to infiltrate or run-off before the new batch is discharged. At the same time, the use of impact sprinklers would reduce the energy of the discharging water to levels where erosion is generally not an issue.

4 Design Elements

4.1 Discharge Pipeline

The existing pipeline consists of an insulated and heat traced 54 mm (2 inch) HDPE pipe. This existing pipeline would be extended by about 280 m in southwest direction by laying the new sections of the pipe on the tundra. On a portion of the pipeline, side branches would be located every 30 m to allow the installation of sprinklers.

4.2 Sprinkler System

The sprinklers selected for this conceptual design are agricultural grade impact sprinklers. These sprinklers allow for the distribution of the water on a radius of about 15 m, at a flow rate of 35 L/min. The effective distribution area of each sprinkler is about 700 metres squared.

4.3 Location

The location chosen for the sprinklers is an open area northwest of Quarry #2, as shown in Figure 1. The first sprinkler would be located about 80 meters southwest of the current discharge point. Each subsequent sprinkler would be installed 30 meters apart, aligned on an approximate northeast to southwest direction. A total of seven sprinklers would be installed at the same elevation on a gently sloping area, thus direct downstream flow from each adjacent sprinkler would have minimal overlap. The sprinklers are well away from any flowing or standing water bodies, as identified on the existing maps.

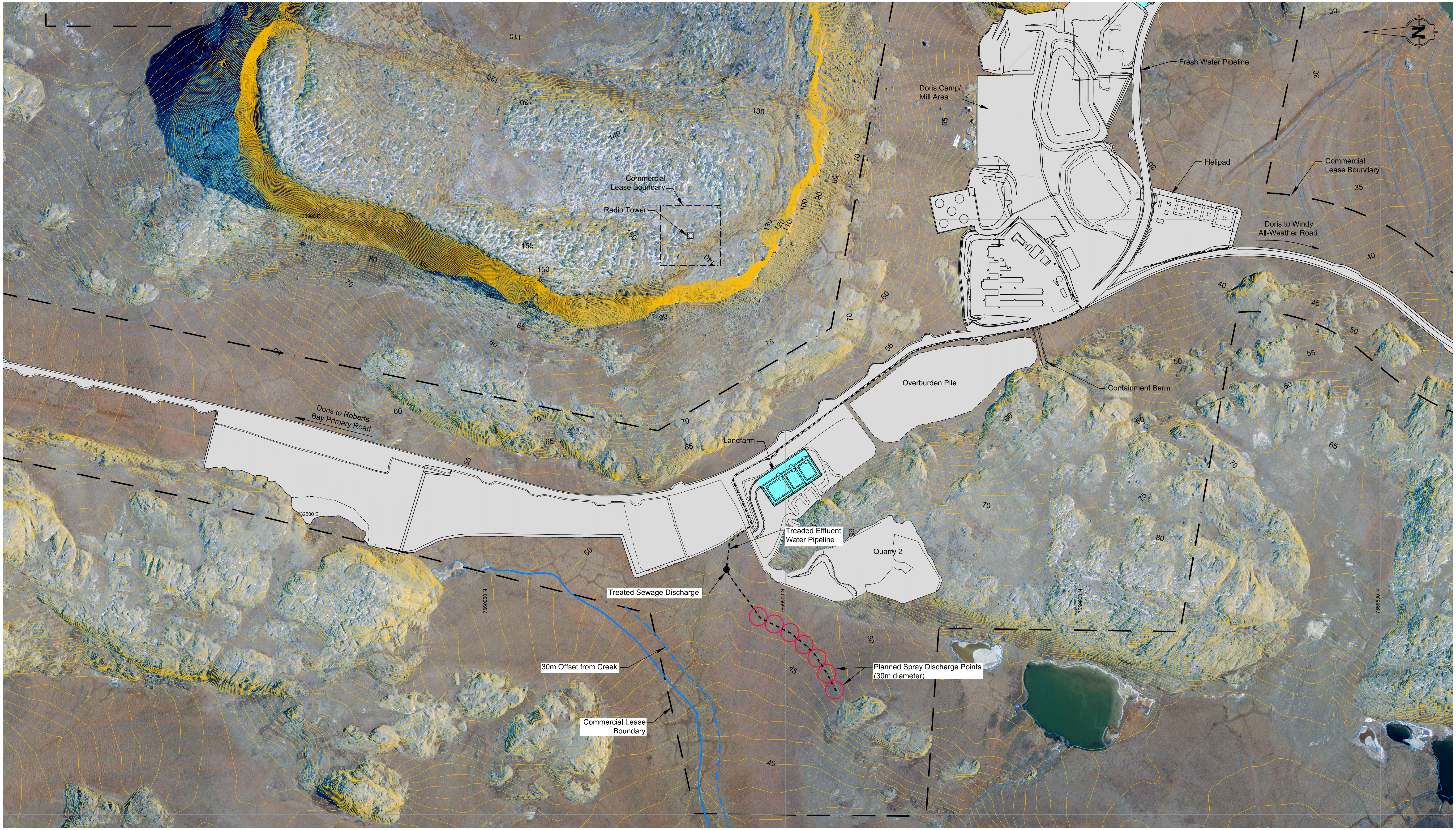
5 Conceptual Operation Plan

In the spring, the sprinkler system would become operational when the ambient air temperature is above freezing. In the fall, the sprinklers would be operated until frozen surface conditions are present, after which the direct discharge method could be employed.

In the winter the sprinklers would be removed, allowing the accumulation of ice adjacent to the discharge point. Creating several smaller ice masses opposed to one large one would be beneficial in the spring, reducing the infiltration and run-off volumes from one specific point.

Construction of the pipeline extension would ideally be performed in the winter, as to minimise disturbance to the tundra. If occasional summer access will be required for maintenance, the sprinklers could be accessed on a relatively short path from Quarry #2.

Figures



0 30 60 90 120 150
Scale in Metres

SRK Consulting
Engineers and Scientists
Vancouver B.C.

SRK JOB NO.: 1CH008.007-300
FILE NAME: Site Plan_Sewage Discharge.dwg

NEWMONT
NORTH AMERICA

HOPE BAY MINING LTD.

Doris North Project

Type 'A' Water License Amendment
Sewage Treatment Plant
Discharge Area

DATE:	APPROVED:	FIGURE:
Oct. 2010	IM	1

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Attachment A
Options Considered for Sewage Treatment Effluent Outfall

Kang, Seema

From: Rykaart, Maritz
Sent: Tuesday, January 05, 2010 10:25 AM
To: 'Chris Hanks'; 'Bill Patterson'; Black, Ken
Cc: Wade, Lowell
Subject: Hope Bay Sewage Effluent Discharge

Chris/Bill

As I have mentioned to you we are concerned about the practice of discharging treated sewage effluent to the tundra due to the risk of permafrost degeradation. As you know the whole premise about land application is that the effluent would infiltrate the soil profile and thereby take a “very long´time” to reach any water body. We realize that this is a practice that has been done for a long time at site, as well as at other arctic sites, but our concern stems from the fact that the loadings will substantially increase as the camp capacity increases, year round operation is anticipated and the period for continuing this practice could be up to the 3rd or 4th quarter of 2012.

To illustrate the infiltration concerns we have done a simple infltration assessment of treated sewage effluent into the active layer of clay and silt at the discharge location. We used standard soil properties and known soil properties from previous geotechnical invetigations. Predicted camp loadings and estimated water usage of 285 L/person-day were used to determine the effluent discharge. Infiltration was estimated for two scenarios, when the infiltration capacity of the receiving soils is unlimited and when the infiltration capacity is limited.

The inputs and assumptions of the unlimited soil estimate include: (1) two infiltration areas of 1.5 ha each; (2) effluent discharged in the winter months freezes and infiltrates during the first month of thaw; (3) suction head of 0.31 m; (4) hydraulic conductivity of 1.4×10^{-7} m/s; and (5) effective porosity of 0.46. Based on these assumptions two (2) areas of 1.5 ha each are sufficient to infiltrate the effluent water without significant ponding. A schedule of the discharge distribution required to minimize ponding is presented below, assuming effluent discharge on tundra commenced July 2009 and completes May 2012.

Area 1:
- July 2009 – May 2010
- April 2011 – Nov 2011
- May 2012

Area 2:
- June 2010 – March 2011
- Dec 2011 – April 2012

The estimate above is based on the assumption that infiltration capacity of the soil is unlimited; however, in reality the active layer of soil available for infiltration of water is 0.5 to 1.0 m thick, limiting the amount of water can be infiltrated. The soil infiltration capacity assuming a 1.0 m active layer and an effective porosity of 0.42 can be estimated as 6,945 m^3 for a 1.5 ha infiltration area. Based on estimated camp loading this capacity would be exceeded by April 2010. A quick calculation suggests that for an active layer of 1.0 m a total area of 16.3 ha is required to infiltrate the total predicted effluent discharge of the Doris Camp (69,303 m^3). Therefore, clearly this approach is not reasonable and prolonged ponding is likely to result in permafrost degradation which is extremely difficult and expensive to repair.

A number of strategies to overcome this problem have been suggested by various parties: These can briefly be summarized as follows:

- Strategy #1 (Leave as is and apply mitigation): Continuing the practice of a single point discharge will undoubtedly result in prolonged ponding with subsequent vegetation dieback and permafrost degradation. Continuing with this practice would imply that HBML would have to commit to repairing the damage by infilling the area with rock to stabilize the damaged area and stop further ponding once land application ceases. It could be argued that this approach is OK since the repaired area could be used as additional laydown area. It would however be difficult to estimate how significant the damage may be. Careful monitoring would have to be done to ensure the problem does not snowball uncontrollably.

- Strategy #2 (Install a diffuser): A diffuser would simply reduce the exit energy, but erosion per se is not really the issue and therefore we do not believe this strategy would offer any real benefit.

- Strategy #3 (Spread the load): As illustrated by the analysis above, we need to spread the load over 16 ha of surface area if we do not want to exceed the infiltration capacity of the natural soils. If we assume unlimited infiltration capacity (unreasonable assumption) we need two discharge areas measuring about 1.5 ha each. This means that we would need to relocate the point of discharge very frequently to provide the necessary coverage. This would be labor intensive and since the infiltration capacity would most definitely be exceeded ponding would still occur and the risk of permafrost degradation remain.

- Strategy #4 (discharge to Doris Lake): This would be easy and convenient but based on comments from Rescan there is a real risk of fish kill which would mean this is a non-starter.

- Strategy #5 (Discharge to Tail Lake): This would be relatively easy and convenient, but again the risk of fish kill remain. Tail Lake could be fished out earlier, but until the North Dam is in place the risk remain.

- Strategy #6 (Discharge upslope of Tail Lake): This would be the same as Strategy #1, but since in the long term the Tail Lake slopes would be covered in tailings the mitigation costs may not have to be incurred. It would however remain a closure liability for a long time.

- Strategy #7 (Construct conventional effluent ponds): This would likely require substantial permitting amendments and the final water discharge still remain an issue.

- Strategy #8 (Discharge to ocean): Same issues as Doris Lake.

Based on the information as presented, we think that Strategy #6 should be explored as a first priority. Failing that Strategy #1 is probably the most reasonable – at least you know your issues.

Once you have had an opportunity to think this over we would be happy to explore this or other options.

Regards
Maritz

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